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LISTS OF SPECIES

Fish, tributaries of middle Rio Mogi Guaçu, upper rio Paraná basin, São Paulo state, Southeastern Brazil

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Abstract: In this paper we compiled a fish list obtained from field collections performed between 1999 and 2005 in four tributaries of the Rio Mogi Guaçu, upper Rio Paraná basin, São Paulo State, Brazil. The collected fishes belong to six orders, 21 families, 60 genera and 82 species. The number of species represents 20 to 30% of the fish richness for the entire upper Rio Paraná basin according to recent estimates. A comparison to earlier published fish lists of the Rio Mogi Guaçu basin, chiefly from its main river channel, is also presented.

Introduction

The fish fauna of the state of São Paulo is one of the more exhaustively studied in the Neotropics (Langeani et al. 2007). A great number of these studies were focused on the species inhabiting the Rio Mogi Guaçu basin, a major tributary of the Rio Grande, which confluences into the Rio Paranaíba and forms the Rio Paraná. From early 19th century to nowadays, several papers dealing with species description, fish biology and community ecology of the Rio Mogi Guaçu basin have been published (e.g. Ihering 1929; Schubart 1962; Godoy 1975; Oliveira and Garavello 2003; Apone et al. 2008).

In this paper we present an updated check list of fish species compiled from six years of collecting efforts carried out in four small tributaries that flow to the floodplain area of the middle Rio Mogi Guaçu. Species composition is compared to earlier published studies (Schubart 1962; Galetti et al. 1990; Gonçalves and Braga 2008) dealing with the ichthyofauna of other environments of the Rio Mogi Guaçu basin, such as its mainstream, floodplain oxbow lakes and reservoirs.

Material and methods

Fish specimens were collected from 1999 to 2005 during previous studies dealing with longitudinal and seasonal distribution of species in four affluent rivers of the Rio Mogi Guaçu. Oliveira and Garavello (2003) studied the fish fauna from Ribeirão Cabaceiras, Birindelli and Garavello (2005) from Ribeirão Araras, Perez Jr. and Garavello (2007) from Rio do Pântano and Apone et al. (2008) from Rio Quilombo (Figure 1). Three sample sites were visited in Ribeirão Cabaceiras: Cab 1 (21°49'11" S, 47°57'55" W), Cab 2 (21°47'53" S, 47°58'29" W) and Cab 3 (21°42'20" S, 47°57'44" W); three sites were sampled in Ribeirão Araras: Ara 1 (21°52'18" S, 47°53'24" W), Ara 2 (21°48'48" S, 47°51'28" W) and Ara 3 (21°43'09" S, 47°50'05" W); four sites sampled in Rio Quilombo drainage: Neg (21°59'53" S, 47°47'50" W), Qui 1 (21°54'54" S, 47°45'48" W), Qui 2 (21°50'36" S, 47°47'36" W) and Qui 3 (21°46'23" S, 47°46'44" W); and three sites were sampled in Rio Pântano: Pan 1 (21°57'28" S, 47°40'15" W), Pan 2 (21°51'26" S, 47°41'43" W) and Pan 3 (21°44'31" S, 47°40'13" W).

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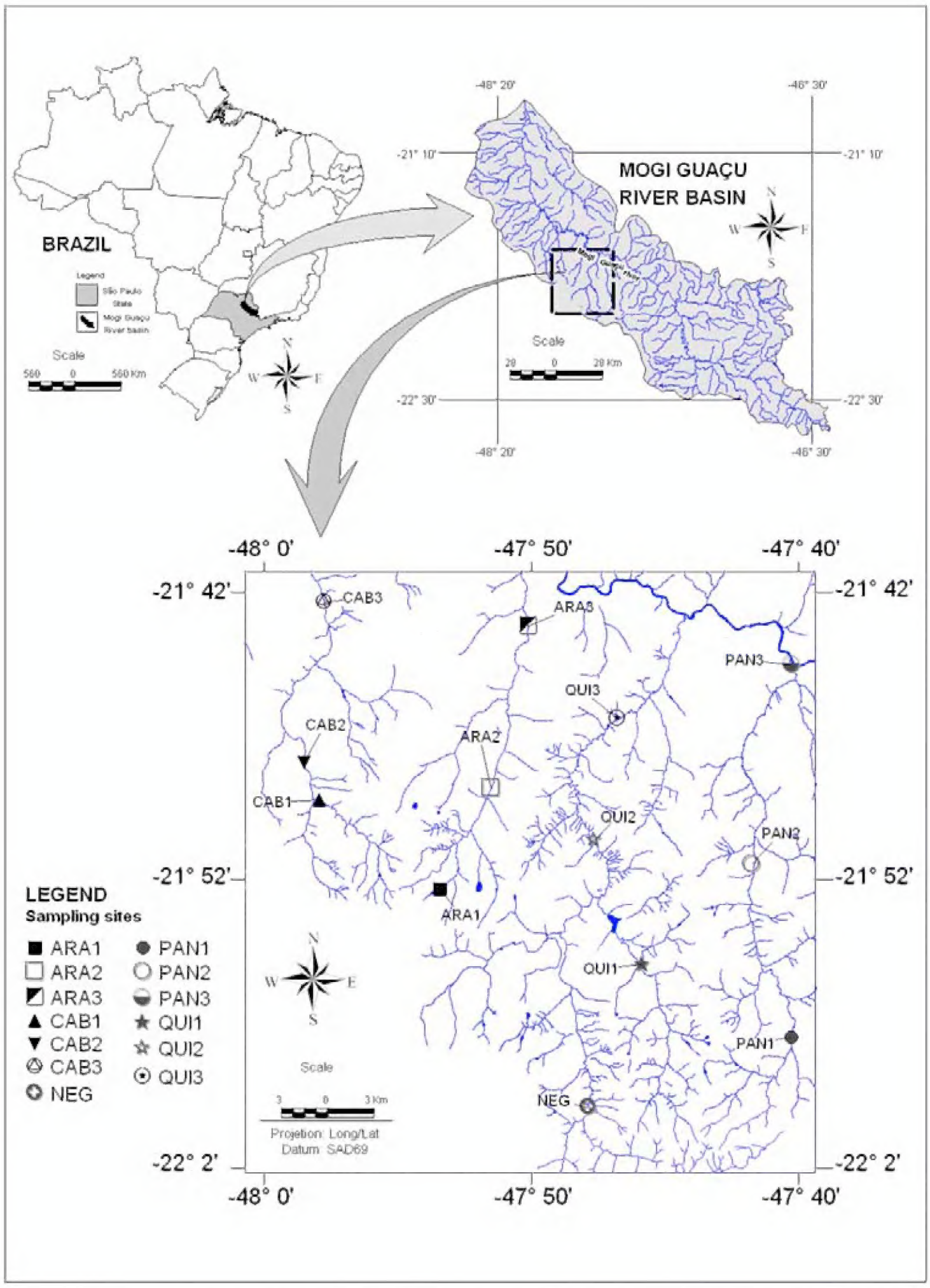

Figure 1. Map showing the location of the Rio Mogi Guaçu basin in Brazil and sampled sites in the four tributaries studied. Cab - Ribeirão Cabaceiras, Ara - Ribeirão Araras, Neg - Ribeirão dos Negros, an affluent of Rio Quilombo, Qui - Rio Quilombo, Pan - Rio do Pântano.

Collections were authorized by *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* (Process IBAMA/MMA # 02027.015501/03-79). Fishes were collected with a casting net (12 mm mesh), a small trawl net (3 mm mesh), gill nets (from 15 to 35 mm mesh) and sieves (5 mm mesh). They were immediately preserved in 10% formalin solution and in the

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laboratory conserved in 70% ethanol. Specimens identification was based on specialized literature of systematic and taxonomy of Neotropical freshwater fishes and on compared material deposited in the fish collection of the *Laboratório de Ictiologia Sistemática* of the *Departamento de Ecologia e Biologia Evolutiva* (LISDEBE) of the *Universidade Federal de São Carlos*, where voucher specimens of this research are also deposited. Fish classification follows Reis et al. (2003), except for the recent proposed subfamily Otothyrinae (Chiachio et al. 2008).

Results and discussion

The 13,168 specimens collected belong to six orders, 21 families, 60 genera and 82 species (Table 1). As observed in almost all studies dealing with Neotropical fish diversity, Characiformes and Siluriformes were the species richest orders registered, comprising more than 85% of the total. The other four orders registered Gymnotiformes, Cyprinodontiformes, Perciformes and Synbranchiformes are also widely distributed in Brazilian river basins and usually present less diversity relative to Characiformes and Siluriformes. The total number of species observed in the four tributaries studied represents 20% to 30% of entire upper Rio Paraná ichthyofauna, according to recent literature (Langeani et al. 2007).

Among drainages, fish richness ranged from 48 species in Ribeirão Cabaceiras to 68 species in Rio Quilombo. Total richness registered for all study area may be interpreted as consequence of each tributary fish composition, but most species were shared between two or more rivers. Thirty-seven species were registered in all four rivers, eleven in three rivers and eighteen in two rivers. The sixteen species found in only one of the studied basins occurred in Quilombo or Pântano rivers, the two richest basins studied.

An important factor that explains total richness found is the diversity of fish habitats explored. Sample sites in each of four small river drainages were longitudinally distributed, including creek habitats near the source and main channel with associated flooded habitats near the mouth of each river. Different kind of environment explored allowed the inventory of distinct fish species and the sample sites near the mouth invariably showed more species than creeks habitats.

Previous fish inventories in Rio Mogi Guaçu were mainly focused on the main river channel and oxbow lakes. Comparisons between the fish list presented here and the lists provided by some of these studies (e.g., Schubart 1962; Galetti et al. 1990) show that the lower stretches of the tributaries of Rio Mogi Guaçu present an ichthyofaunistic composition very similar to that found in environments with greater water volume in the basin.

Schubart (1962) presented a list of 94 fish species resulted of many years of research in the main channel of the Rio Mogi Guaçu, at Cachoeira de Emas, in the *Estação Experimental de Biologia e Piscicultura* located in Pirassununga. Taxonomical problems apart, the majority of fishes listed by Schubart were found in the rivers studied herein, especially for those of the families Anostomidae, Curimatidae, Parodontidae, Prochilodontidae, Heptapteridae, and many species of the families Characidae and Loricariidae. The species that were recorded by Schubart (1962) but were not represented herein comprises those of the groups Bryconinae, Trichomycterinae, Auchenipteridae and Apteronotidae, and the introduced species of the family Cyprinidae.

Galetti et al. (1990) studied two oxbow lakes in an area of environmental protection and listed 36 fish species, from which only two species were not found in the tributaries of Mogi Guaçu herein sampled, the characid *Salminus brasiliensis* (Cuvier, 1816) and an auchenipterid species referred by the authors as *Trachycorystes* sp.

The most recent list of fish from Rio Mogi Guaçu published presents 41 species in a reservoir and oxbow lakes located downstream of the UHE Mogi Guaçu (Gonçalves and Braga 2008). The only species not sampled by us are: *Metynnis maculatus* (Kner, 1858), *Prochilodus vimboides* Kner, 1859, *Eigenmannia trilineata* López & Castello, 1966, *Parauchenipterus galeatus* (Linnaeus, 1758), *Iheringichthys labrosus* (Lütken, 1874) and *Pimelodus* cf. *fur* (Lütken, 1874).

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Most of these species registered only in previous studies, are medium to large sized species frequently found in the main channel of Rio Mogi Guaçu and their absence in our list is probably due to the kind of environment here sampled. Nevertheless, these and other medium to large sized species may occur in the stretches near the mouth of the tributaries herein studied, as other transient species that colonize the tributaries of the main channel during the wet season, as showed in earlier publications (Oliveira and Garavello 2003; Birindelli and Garavello 2005; Perez Jr. and Garavello 2007; Apone et al. 2008).

In a recent review about fish studies in Rio Mogi Guaçu Meschiatti and Arcifa (2009) compiled a list of 150 species. The review reported a hundred years of ichthyological studies in the Rio Mogi Guaçu, as stated: "The first study (Boulenger, 1900) described *Loricaria latirostris* from specimens caught in this river". However, the studies date back 150 years ago, since Rudolf Kner's descriptions of fish species from Irisanga (= Orissanga), locality in Mogi Guaçu basin, São Paulo State, according to Britski and Garavello (1978).

The number of species reported in the review is doubtful because the taxonomical criteria presented is vague, with clear mistakes derived from species names compiled from literature and without any mention about fish specimens examined or deposited in fish collections. So, approximately 10 % of the species listed by Meschiatti and Arcifa (2009) are put in doubt herein, chiefly because some of the species names presented in their review were compiled from a list of material examined presented in A. K. Oliveira's unpublished thesis, which also includes doubts on some fish specimens identity. The remaining approximately 135 species cited in the review may occur in the Rio Mogi Guaçu and, if so, the species richness found in the four tributaries studied by us represents about 60% of the fish assemblage in the basin.

The list presented herein shows that small to medium tributaries shelter a high diversity of fish species that are, in most cases, not well studied in terms of their ecological and biological traits. Those environments are also important because their species contribute to the total fish richness in Rio Mogi Guaçu. In fact, there is little information about how local richness influences regional diversity and contrariwise in Rio Mogi Guaçu basin.

Table 1. List of fish species registered in the tributaries of Rio Mogi Guaçu, from 1999 to 2005. Cab = Ribeirão Cabaceiras, Ara = Ribeirão Araras, Qui = Rio Quilombo, Pan = Rio do Pântano and LISDEBE represents number of voucher specimens. *Asterisk indicates introduced species according to Langeani et al. (2007).

Taxon	Cab	Ara	Qui	Pan	LISDEBE
CHARACIFORMES					
Parodontidae					
Apareiodon affinis (Steindachner, 1879)	X		X		1395
Apareiodon piracicabae (Eigenmann, 1907)			X		1303
Parodon nasus Kner, 1859	X	X	X	X	1211
Curimatidae					
Cyphocharax modestus (Fernández-Yépez, 1948)		X	X	X	1434
Cyphocharax nagelii (Steindachner, 1881)			X		1329
Steindachnerina insculpta (Fernández-Yépez, 1948)	X	X	X	X	1481
Prochilodontidae					
Prochilodus lineatus (Valenciennes, 1836)	X	X	X	X	1272
Anostomidae					
Leporellus vittatus (Valenciennes, 1850)		X	X	X	1273
Leporinus elongatus (Valenciennes, 1850)			X		1380
Leporinus friderici (Bloch, 1794)	X	X	X	X	1379
Leporinus lacustris Campos, 1945	X		X		1332

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Taxon	Cab	Ara	Qui	Pan	LISDEBE
Leporinus obtusidens (Valenciennes, 1836)			X	X	1290
Leporinus octofasciatus Steindachner, 1915		X		X	596
Leporinus paranensis Garavello & Britski, 1987			X	X	1417
Leporinus striatus Kner, 1858	X	X	X	X	1333
Schizodon nasutus Kner, 1858	X		X		1274
Crenuchidae					
Characidium gomesi Travassos, 1956	X	X	X	X	1184
Characidium aff. *zebra* Eigenmann, 1909	X	X	X	X	1183
Characidae *Incertae sedis*					
Astyanax altiparanae Garutti & Britski, 2000	X	X	X	X	1173
Astyanax fasciatus (Cuvier, 1819)	X	X	X	X	1233
Astyanax paranae Eigenmann, 1914	X	X	X	X	1166
Bryconamericus stramineus Eigenmann, 1908	X	X	X	X	1252
Gymnocorymbus ternetzi (Boulenger, 1895)*	X	X		X	679
Hemigrammus marginatus Ellis, 1911	X	X	X	X	1319
Hyphessobrycon anisitsi (Eigenmann, 1907)			X	X	1174
Hyphessobrycon bifasciatus Ellis, 1911		X		X	608
Hyphessobrycon eques (Steindachner, 1882)	X	X	X	X	1320
Moenkhausia intermedia Eigenmann, 1908			X		1344
Moenkhausia sanctaefilomenae (Steindachner, 1907)	X	X	X	X	1321
Oligosarcus pintoi Campos, 1945	X	X	X	X	1182
Piabina argentea Reinhardt, 1867	X	X	X	X	1207
Salminus hilarii Valenciennes, 1850	X	X	X	X	1351
Serrasalminae					
Myleus tiete (Eigenmann & Norris, 1900)		X	X		1393
Serrasalmus cf. *maculatus* Kner, 1858	X		X		1456
Aphyocharacinae					
Aphyocharax dentatus Eigenmann & Kennedy, 1903			X		1475
Characinae					
Galeocharax knerii (Steindachner, 1879)			X		1375
Cheirodontinae					
Cheirodon stenodon (Eigenmann, 1915)	X	X	X	X	1223
Odontostilbe sp.			X		1253
Serrapinnus heterodon (Eigenmann, 1915)	X	X	X	X	1254
Serrapinnus notomelas (Eigenmann, 1915)	X	X	X	X	1350
Acestrorhynchidae					
Acestrorhynchus lacustris (Lütken, 1875)	X		X		1327
Erythrinidae					
Hoplerythrinus unitaeniatus (Spix & Agassiz, 1829)*	X	X		X	583
Hoplias aff. *malabaricus* (Bloch, 1794)	X	X	X	X	1328
SILURIFORMES					
Cetopsidae					
Cetopsis gobioides Kner, 1858		X	X		1243
Aspredinidae					
Bunocephalus sp.			X		1487
Trichomycteridae					
Stegophilinae					
Parastegophilus paulensis (Miranda-Ribeiro, 1918)			X	X	1312
Vandelliinae					
Paravandellia oxyptera Miranda-Ribeiro, 1912		X	X	X	1313
Callichthyidae					
Callichthys callichthys (Linnaeus, 1758)		X	X	X	1177

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Taxon	Cab	Ara	Qui	Pan	LISDEBE
Corydoras aeneus (Gill, 1858)	X	X	X	X	1170
Corydoras difluviatilis Britto & Castro, 2002				X	2585
Hoplosternum littorale (Hancock, 1828)	X	X	X	X	1508
Lepthoplosternum pectorale (Boulenger, 1895)			X	X	1400
Megalechis personata (Ranzani, 1841)*	X	X	X	X	1338
Loricariidae					
Neoplecostominae					
Neoplecostomus paranensis Langeani, 1990			X		1187
Otothyrinae					
Hisonotus depressicauda (Miranda-Ribeiro, 1918)	X	X	X	X	1438
Hisonotus insperatus Britski & Garavello, 2003	X	X	X	X	1247
Loricariinae					
Loricaria lentiginosa Isbrücker, 1979				X	2589
Rineloricaria latirostris (Boulenger, 1900)	X	X	X	X	1276
Hypostominae					
Hypostomus ancistroides (Ihering, 1911)	X	X	X	X	1169
Hypostomus nigromaculatus (Schubart, 1964)			X		1246
Hypostomus regani (Ihering, 1905)				X	2587
Hypostomus paulinus (Ihering, 1905)	X			X	2588
Hypostomus cf. *strigaticeps* (Regan, 1908)	X			X	1941
Hypostomus sp.	X	X	X	X	1931
Heptapteridae					
Cetopsorhamdia iheringi Schubart & Gomes, 1959	X	X	X		1259
Imparfinis schubarti (Gomes, 1956)	X	X	X	X	1309
Phenacorhamdia tenebrosa (Schubart, 1964)		X	X	X	1241
Pimelodella sp.	X	X	X	X	1227
Rhamdia cf. *quelen* (Quoy & Gaimard, 1824)	X	X	X	X	1506
Pimelodidae					
Pimelodus maculatus Lacépède, 1803	X			X	2586
GYMNOTIFORMES					
Gymnotidae					
Gymnotus sp.	X	X	X	X	1363
Sternopygidae					
Eigenmannia cf. *virescens* (Valenciennes, 1836)	X	X	X	X	1364
Hypopomidae					
Brachyhypopomus cf. *pinnicaudatus* (Hopkins, Comfort, Bastian & Bass, 1990)		X		X	601
CYPRINODONTIFORMES					
Poeciliidae					
Phalloceros harpagos Lucinda, 2008		X	X	X	1188
Poecilia reticulata Peters, 1859*		X	X	X	1171
SYNBRANCHIFORMES					
Synbranchidae					
Synbranchus marmoratus Bloch, 1795	X	X	X	X	1491
PERCIFORMES					
Cichlidae					
Australoheros sp.				X	2417
Crenicichla jaguarensis Haseman, 1911	X	X	X	X	1249
Geophagus brasiliensis (Quoy & Gaimard, 1824)	X	X	X	X	1172
Laetacara sp.				X	1830
Oreochromis niloticus (Linnaeus, 1758)*				X	2445
Tilapia rendalli (Boulenger, 1897)*		X	X	X	1180
Total of species	48	53	68	64	

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